Application of conjugate gradient approach for nonlinear optimal control problem with model-reality differences

ABSTRACT

In this paper, an efficient computational algorithm is proposed to solve the nonlinear optimal control problem. In our approach, the linear quadratic optimal control model, which is adding the adjusted parameters into the model used, is employed. The aim of applying this model is to take into account the differences between the real plant and the model used during the calculation procedure. In doing so, an expanded optimal control problem is introduced such that system optimization and parameter estimation are mutually interactive. Accordingly, the optimality conditions are derived after the Hamiltonian function is defined. Specifically, the modified model-based optimal control problem is resulted. Here, the conjugate gradient approach is used to solve the modified model-based optimal control problem, where the optimal solution of the model used is calculated repeatedly, in turn, to update the adjusted parameters on each iteration step. When the convergence is achieved, the iterative solution approaches to the correct solution of the original optimal control problem, in spite of model-reality differences. For illustration, an economic growth problem is solved by using the algorithm proposed. The results obtained demonstrate the efficiency of the algorithm proposed. In conclusion, the applicability of the algorithm proposed is highly recommended.

Keyword: Nonlinear optimal control; Conjugate gradient approach; Iterative solution; Adjusted parameters; Model-reality differences